

WHAT IS CLAIMED IS:

1. A communication device using a communication protocol with data loss compensation functions provided at both an upper layer and a lower layer, comprising:

a packet storage unit configured to store a plurality of packets to be transmitted to another communication device;

a connection identification unit configured to identify an upper layer connection to which each packet stored by the packet storage unit belongs;

a transmission state management unit configured to manage a transmission state of each upper layer connection identified by the connection identification unit;

a packet transmission unit configured to transmit each packet stored by the packet storage unit; and

a packet transmission order control unit configured to control a transmission order among the plurality of packets to be transmitted by the packet transmission unit at the lower layer, according to the transmission state managed by the transmission state management unit, such that when the packet storage unit stores at least one non-transmitted packet for each one of at least two different upper layer connections, at least two packets to be transmitted by the packet transmission unit consecutively are belonging to different upper layer connections.

2. The communication device of claim 1, wherein the upper layer is a transport layer and the lower layer is a link layer.

3. The communication device of claim 1, wherein the packet transmission unit transmits the plurality of packets through an unstable channel in which an effective bandwidth varies.

4. The communication device of claim 3, wherein the packet transmission order control unit controls the transmission order such that the unstable channel is
5 utilized by a plurality of upper layer connections evenly.

5. The communication device of claim 1, wherein the transmission state management unit manages the transmission state that indicates whether a packet belonging to each
10 upper layer connection has been transmitted before or not, with respect to each upper layer connection.

6. The communication device of claim 5, wherein the packet transmission order control unit resets the
15 transmission state of each upper layer connection managed in the transmission state management unit when the packet storage unit stores at least one non-transmitted packet for each one of at least two different upper layer connections and there is no upper layer connection whose packets have
20 not been transmitted before among upper layer connections identified by the connection identification unit, at a time of selecting a next transmission packet.

7. The communication device of claim 5, wherein the
25 packet transmission order control unit selects a packet belonging to an upper layer connection whose packets have not been transmitted before according to the transmission state managed by the transmission state management unit, as a next transmission packet.

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8. The communication device of claim 1, further comprising:

an upper layer congestion control unit configured to control a start of a congestion control at the upper layer
35 according to an amount of packets stored in the packet

storage unit.

9. The communication device of claim 1, wherein the communication device is a communication terminal device
5 which further comprises:

an interface connected to the another communication device, through which packets are transmitted/received to/from the another communication device.

- 10 10. The communication device of claim 1, wherein the communication device is a communication relay device which further comprises:

a first interface connected to a prescribed network;
a second interface connected to the another

- 15 communication device; and

a relay unit configured to receive packets from a terminal on the network through the first interface and transmit received packets to the another communication device through the second interface.

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11. A communication control method for controlling a communication device using a communication protocol with data loss compensation functions provided at both an upper layer and a lower layer, the method comprising comprising:

- 25 storing a plurality of packets to be transmitted to another communication device;

identifying an upper layer connection to which each packet stored by the storing step belongs;

- 30 managing a transmission state of each upper layer connection identified by the identifying step;

transmitting each packet stored by the storing step;
and

- controlling a transmission order among the plurality of packets to be transmitted by the transmitting step at
35 the lower layer, according to the transmission state

managed by the managing step, such that when the storing
step stores at least one non-transmitted packet for each
one of at least two different upper layer connections, at
least two packets to be transmitted by the transmitting
5 step consecutively are belonging to different upper layer
connections.

12. A computer usable medium having computer readable
program codes embodied therein for causing a computer to
10 function as a communication device using a communication
protocol with data loss compensation functions provided at
both an upper layer and a lower layer, the computer
readable program codes include:

a first computer readable program code for causing
15 said computer to store a plurality of packets to be
transmitted to another communication device;

a second computer readable program code for causing
said computer to identify an upper layer connection to
which each packet stored by the first computer readable
20 program code belongs;

a third computer readable program code for causing
said computer to manage a transmission state of each upper
layer connection identified by the second computer readable
program code;

25 a fourth computer readable program code for causing
said computer to transmit each packet stored by the first
computer readable program code; and

a fifth computer readable program code for causing
said computer to control a transmission order among the
30 plurality of packets to be transmitted by the fourth
computer readable program code at the lower layer,
according to the transmission state managed by the third
computer readable program code, such that when the first
computer readable program code stores at least one non-
35 transmitted packet for each one of at least two different

upper layer connections, at least two packets to be transmitted by the fourth computer readable program code consecutively are belonging to different upper layer connections.

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13. A communication device using a communication protocol with data loss compensation functions provided at both an upper layer and a lower layer, comprising:

10 a packet storage unit configured to store a plurality of packets to be transmitted to another communication device;

a connection identification unit configured to identify an upper layer connection to which each packet stored by the packet storage unit belongs;

15 a transmission state management unit configured to manage a transmission state of each upper layer connection identified by the connection identification unit;

a packet transmission unit configured to transmit each packet stored by the packet storage unit; and

20 a packet transmission order control unit configured to control a transmission order of the plurality of packets stored in the packet storage unit, at the lower layer, according to the transmission state managed by the transmission state management unit, such that a level of
25 continuity of packets belonging to each upper layer connection in the transmission order becomes not higher than a level of continuity of packets belonging to each upper layer connection in a storing order by which the plurality of packets are stored in the packet storage unit.

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14. The communication device of claim 13, wherein the data loss compensation function provided at the lower layer is dynamically adapted to a level of data loss.

35 15. The communication device of claim 13, further

comprising:

an upper layer congestion control unit configured to
control a start of a congestion control at the upper layer
according to an amount of packets stored in the packet
5 storage unit, by marking or discarding upper layer packets
selectively.

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